COÖRDINATION OF WATER AND FIRE DEPARTMENTS' RELATED ACTIVITIES[1]

By Clarence Goldsmith[2]

The general requirements which are imposed upon waterworks systems for adequate and reliable fire service are in the main standardized and well understood by waterworks engineers and superintendents. In order that all the facilities available in both the water and fire departments may function up to as nearly 100 per cent of their ability and capacity during the progress of a fire, it is necessary that the two departments combine their efforts in harmonious action. If this is to be brought about, the heads of each department should make a thorough study together of the many conditions which might arise and formulate definite plans to secure maximum unity in operation before the fire or emergency occurs.

Alarms of fire should sound in some quarters of the water department and a responsible employee familiar with the system should respond to fire alarms in mercantile districts and second alarm elsewhere. An emergency motor-driven truck loaded with necessary tools should be provided for general emergency work and may be used for response to fires as well.

The value of such response should not be underestimated. It is equally important in small as in large cities. In the smaller places the fire department may be mainly or wholly composed of call men or volunteers and frequently, because of lack of training, they do not understand the operation of the hydrants. For instance, a waterworks man can readily place a wrench on a hydrant outlet cap which is stuck and with a sharp kick start the cap, while one inexperienced in such cases could not remove the cap. Cases have been known where firemen did not know in which direction to turn the hydrant stem nut to open the hydrant and broke the stem off by trying to turn it in the wrong direction. Many times it has been found that the foot valve or independent valve on a hose outlet

[1] Read before the meeting of the Illinois Section, March 30, 1922.

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has not been opened wide in cases where it was claimed that sufficient pressure at the nozzle or sufficient suction supply to the pumper or steamer was not available. Such a case may be promptly corrected by a waterworks man, provided he is present.

In cases where large service connections enter the building, which is on fire, and these connections serve only domestic and process water, they should be shut off immediately. If such connections serve standpipes or automatic sprinkler equipment, the waterworks representative should find the valve box in the street or sidewalk which controls the connection and be prepared to close the valve in case the chief of the fire department finds that the inside piping system has failed and undue quantities of water are being delivered into the building and not on the fire. It should be remembered always, however, that sprinkler heads operating in the area involved by the fire are delivering water onto the seat of the fire to better advantage than can be done ordinarily by hose streams. The chief of the fire department should ascertain from the water department the approximate quantity of water which the distribution system can deliver into each sprinkler equipment at a pressure sufficient to operate effectively the sprinkler heads at the highest elevation. If this knowledge has been obtained, it will be possible for the fire department to increase the supply where deficient by connecting hose lines from pumpers to the steamer connections of the sprinkler equipment, provided for this purpose. In any case, the rules of the department should require the second hose line laid to be connected to the steamer connection.

Alarms should sound in pumping stations of the direct pumping system. Where pressures are raised to furnish hydrant streams or pumps are started to furnish fire service, duplicate alarm circuits should be provided, as to fire stations. In cities and towns having no fire alarm telegraph systems, dependence has to be placed on the telephone, but this means of transmitting alarms cannot be considered as satisfactory as alarm circuits of the fire alarm system.

In water systems supplied by direct pumpage, it is generally necessary to start additional pumps in case any considerable water is required to extinguish a fire. In small cities and towns the fire flow rate required is considerably in excess of the domestic consumption rate. In a city having 17,000 population, the average domestic consumption rate may be about 1,700,000 gallons, but the required fire flow rate is 5,760,000 gallons. It is readily seen that under such

circumstances it is necessary to increase the rate of pumpage for fires of even moderate proportions. In order to increase the supply promptly upon receipt of an alarm of fire, it is necessary to be able to force the boilers in service and have a sufficient boiler capacity under one-half steam to start additional pumps.

In this connection plans should be made to make major repairs to pumping units during the seasons of the year when domestic demands are at the minimum, so as to maintain as large a pumping capacity in service as possible, taken in relation to the combined domestic and fire demands.

Where pressures are raised for fires, this question assumes greater importance, for the prevailing domestic rate increases somewhat as the pressure is increased. Wherever direct hydrant hose streams are available, it is advisable for the fire department to provide relief valves for each hose line so that when shut-off nozzles are used the possibility of producing damage by water ram may be obviated.

Each fire station should be provided with a map of the water distribution system showing the size of the mains and the location of the hydrants. All firemen should be intimately acquainted with the location of hydrants, particularly in their districts. Commanding officers should have a general knowledge of the sizes of mains so that proper advantage may be taken when two hydrants are equally available and one is supplied from a large main and one from a small main.

Hydrants should be inspected in the spring and fall of each year. The inspection should include the flushing of the hydrant which will test its operation, greasing the hydrant caps, all of which should be removed, and oiling the packing if it needs it. Before the caps are replaced, it should be ascertained that the drain is operative.

There should be enough hydrants installed so that the water required can be concentrated on any group of buildings through hose lines, none of which shall exceed 500 feet in length. Whether the protection is dependent on pumpers or direct hydrant streams, every effort should be made to cut down the friction loss in hose lines.

The waterworks superintendent or engineer is frequently better versed in handling hydraulic problems than the chief of the fire department, and for this reason, he may be of great assistance along this line. For instance, the question of the friction loss in fire hose

can be determined by the following approximate formula: The loss per hundred feet in 2½-inch rubber-lined fire hose in pounds is equal to 2 q^2 plus q, where q is the quantity in hundred gallons. The discharge in gallons through nozzles of different sizes when attached to different lengths of hose for the ordinary range of engine and hydrant pressure is given in tables contained in the "Red Book" published by the National Board of Fire Underwriters. Every fire chief should have a copy of this publication and become acquainted with its contents.

Another problem which frequently comes up in connection with hose streams is that of the reaction or pull-back of the playpipe under varying conditions of pressure and size of tips. The pull-back in pounds is $1.5 \times d^2 \times p$ where d is the diameter of the nozzle in inches and p is the pressure at the base of the playpipe.

A few examples of the advantages of coöperation between fire and water departments may not be out of place. In one of our larger cities the fire department had great difficulty in getting horse-drawn steamers up a steep hill, although the hose wagons were generally able to negotitate the run, even with snow and ice on the ground. At the top of this hill there had formerly been a reservoir which was served by a 24-inch line. The reservoir had been abandoned and the large main ordinarily carried about 28 pounds pressure, but the fire department had been waiting until the engines arrived before attempting to get hose streams on fires. The major portion of the buildings were 3-story frame structures which burned rapidly. A conference was held between the engineer of the water-works and the chief of the fire department, which resulted in having two hose wagons go to the top of the hill and it was shown that, by the use of ¾-inch tips on the shut-off nozzles, fairly effective fire streams could be thrown without the use of engines.

Weak places in distribution systems and dead ends occur in almost every distribution system. In such cases, where direct hydrant hose streams are depended upon, it frequently happens that the fire department lays out so many lines that none of the hose streams are effective. All such phases should be considered in conference and the fire chief informed of the approximate number of effective streams which can be used at each location.

The water department should have a sample hydrant available so that members of the fire department may be instructed in regard to the mechanical operation of the hydrant, for without such knowledge much serious abuse of hydrants is liable to occur.

Adequate pressures are necessary to furnish the service required. Where fire engines are used, sufficient pressure must be maintained in the mains to overcome the friction loss in the hydrant branches and hydrants and to provide sufficient velocity head to get the required water to the steamer or pumper. Ordinarily 20 pounds in the mains when the maximum fire draft is being drawn is sufficient. There has been a tendency during the past few years, because of the necessity of inaugurating all economies in operation, to reduce pressures on water distribution systems at night. Care should be taken not to reduce pressures to such an extent that existing sprinkler equipments cannot receive a proper supply on the upper line of sprinkler heads. Even where pumpers are used to develop the hose streams, it is important to maintain a moderately high pressure on the mains. The rated capacity of pumpers is based upon a discharge pressure of 120 pounds and where long lines of hose are needed, it is necessary to carry higher discharge pressures, which result in reducing the rated capacity of the pumper, for a pumper will only deliver about one-half its rated capacity at 200 pounds discharge pressure, and only about one-third its rated capacity at 250 pounds pressure. It is readily seen that if 220 pounds discharge pressure were required, and a suction pressure of 100 pounds could be maintained, the pumper could deliver its full rated capacity under these conditions, whereas if the suction pressure were reduced to zero, the capacity of the pumper would be reduced by about one-half.

The operating nuts on hydrants in any city should be of one size. This should include the nuts on the hydrant caps as well as the operating nuts. If brass nuts are on the main stem, they should be looked over carefully at the time of each inspection as they are liable to become so bruised that the hydrant wrench will not fit them.

The hose threads on all hydrants, hose and connections should be of uniform size, preferably that of the national standard hose thread. Where hydrants or hose connections are installed on private property, it is not uncommon to find threads to which the fire department can not connect. It is very desirable that hose threads throughout the country be uniform, and the national board has succeeded in having tools developed by which non-standard hose threads within certain limits can be standardized. The national board has published pamphlets entitled "Standardization of threads for fire hose couplings and fittings" and "Suggested method of procedure for accomplishing the state-wide standardization of threads on fire hose couplings

and fittings." These publications describe the method of handling the standardization problem, and the national board is ready to advise as to the best methods of standardization.

DISCUSSION

D. R. GWINN:[3] The valuable paper presented by Mr. Goldsmith is of much interest. He has made many valuable suggestions and they are certainly worthy of the consideration of every operating waterworks man.

We, in our city, endeavor to keep in close touch with the chief of the fire department. We try to keep him posted on conditions, especially if there should be any unfavorable ones. We make a point of notifying the chief whenever a hydrant is out of commission due to being broken by automobiles, or when water is shut off in the main for making a connection therewith. He is notified also when the hydrant is again in commission.

A tracing of our pipe system, showing all the fire hydrants, is corrected at the beginning of each year and blue prints made so that every fire house in the city may have a corrected copy. A list of manufacturering concerns having private fire hydrants is included in the tracing. The lines showing the mains are graduated so as to show the relative size.

Several years ago, a number of copies were bought of "Practical Hydraulics for Firemen" by Fred Shepperd. A copy was furnished to each fire house in the city, and an extra copy for the chief and superintendent of the fire alarm system. We also furnished the department with half-tone illustrations showing the length of streams attained through different lengths of fire hose at a given pressure.

We have a Matthew fire hydrant with a side section cut away showing the valve and working parts. Occasionally this hydrant is loaded on our truck and taken around to the different fire houses. Recently, Chief Miller went with our man and at each house he called out the firemen to see the operation of the hydrant. At that time, he stated that the other platoon would be on duty soon in the day time and he wanted us to bring the hydrant around again.

We had a 6-inch main broken under fire pressure some years ago. The result was that the fire got away from the department, as it took some little time to shut out the broken section. It is a serious

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question whether high pressure should be raised for fires, especially as we now have such well developed pumpers that can furnish adequate pressure.

At the recent meeting of the Indiana Sanitary & Water Supply Association, a resolution was adopted which I think is worthy of consideration by the Illinois Section. The resolution[4] follows:

Whereas, there are serious objections to the practice of raising water pressure on systems of water mains at time of fire, and

Whereas, the increase of pressure in itself results in more water being discharged through the numerous leaks, which always exist and more water being used through fixtures, damage to plumbing, in the breaking of service pipes, and at times, the breaking of large mains; all at a time when the whole water supply should be strictly conserved; and

Whereas, accidents and break downs to pumping machinery and valves are more apt to occur, and do occur, under the additional strain and during the excitement of raising fire pressure; also increased pressure ordinarily requires that water stored in elevated reservoirs is not available during fires because of being shut off to permit direct pumping into the mains so that at such times an extra strain is placed upon filter plants and there is consequent danger of epidemic following a conflagration, and

Whereas, in handling fires in high buildings, and in the case of other serious hazards, fire departments now require large and powerful streams beyond the capacity of domestic water works systems to supply, and

Whereas, such streams can be furnished by motor pumpers which are well adapted to this requirement and make shorter and more lines of hose available without the heavy expense for equipment and operation which was formerly required in the case of steam fire engines.

THEREFORE, BE IT RESOLVED by the Illinois Section of the American Water Works Association in Convention at Champaign, that we recognize the hazard and expense incurred in raising fire pressure in domestic water mains and we declare it is our opinion that this is undesirable practice and that such method of producing fire pressure should be supplanted as rapidly as may be by motor pumper or other auxiliary apparatus as being more suitable, more economical and in the best interest of the whole people.

D. R. GWINN:[3] I move the adoption of this resolution.

F. C. AMSBARY:[5] I second the motion.

The resolution was adopted unanimously.

[4] A similar resolution was adopted at the annual meeting of the Iowa Section, November 2, 1921. See Journal, January, 1922, page 138. [Editor.]

[5] Manager, Water Company, Champaign, Illinois.

CLARENCE GOLDSMITH:[2] I believe that the Underwriters have in many instances the undeserved reputation of trying to get all they can and then trying to get more. The engineering branch of the business with which I am connected stands for the best modern engineering practice, and we are always ready to adjust our views when the evidence is sufficient to warrant. The resolution as presented has much merit, but one thing should be guarded against; pressures should not be reduced to such an extent that they will not be sufficient to supply automatic sprinklers at the elevation of the highest heads; pressures in mercantile districts of 60 to 70 pounds are generally sufficient. About 75 per cent of fires can be extinguished with chemicals, about 20 per cent can be put out with one $2\frac{1}{2}$-inch hose stream, and only about 5 per cent of fires will require the use of pumpers, all provided the above-mentioned pressures are maintained.